# COMOPTEVFOR VV&A PROCESS

M&S Workshop

14 November 2001

Mr. Robert Ostrowski

Surface Warfare M&S Analyst

(757) 444-5546

ostrowsr@cotf.navy.mil

# Objectives

- Starting Point - OTD Desires to Use M&S to Supplement OT&E
- Need Process to Get Concepts from the OTD to the Developer
  - Intended Uses of M&S
  - Functionality and Fidelity Needed
- Need Process to Get Confidence in M&S
  - Verification and Validation
- Need Project Management Discipline

# COMOPTEVFOR Guidance

- SECNAVINST 5200.40
  - "COMOPTEVFOR will accredit all models and simulations used to supplement OT&E"
  - Specifies the Products
- COMOPTEVFOR INST 5000.1
  - Specifies the Products
  - Discusses the Process and Standardized Approach

# Required Products

- SECNAVINST 5200.40
  - Proponent - VV&A Plan, Implementation, V&V Report,
  - Ensure Config. Mgmt., Data Validity
  - Accreditation Authority - Accreditation Report
- COMOPTEVFORINST 5000.1
  - Proponent - Model Management Plan, Accreditation Package for OT
  - COMOPTEVFOR - Accreditation Plan Input Letter for OT, Report

# Required Products, Cont

- TEMP
  - Part III - Simulations Designated, Intended Uses for DT
  - Part IV - Simulations Designated, Intended Uses for OT
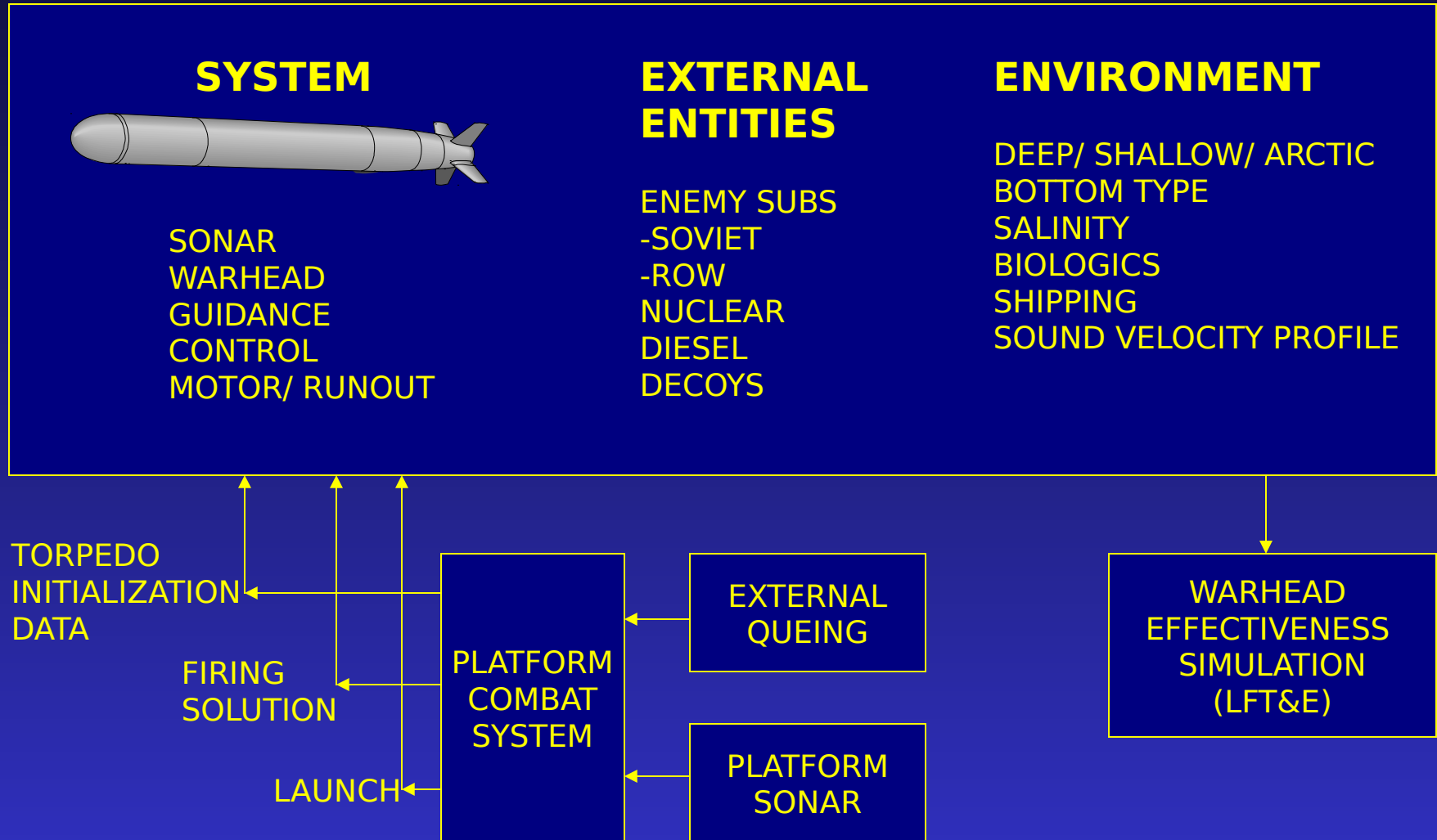  - Part V - Resources (Dollars, Man-Years, Schedule)

# Facilitating the M&S Process

- Key methods to accomplish the objectives and facilitate the process:
  - Early Involvement (with PM, Proponent, Developer, V&V and Accreditation teams)
  - Open Communications/ Dialogue - Facilitates the Staffing of Requirements, Acceptability Criteria, V&V Expectations, Accreditation Reports

# Example - Hypothetical Lightweight Torpedo

- Define the System

- Determine Operational Requirements

- Project Management of the Verification, Validation, and Accreditation Process

# Defining the HLT System

**SYSTEM**

SONAR
WARHEAD
GUIDANCE
CONTROL
MOTOR/ RUNOUT

**EXTERNAL ENTITIES**

ENEMY SUBS
-SOVIET
-ROW
NUCLEAR
DIESEL
DECOYS

**ENVIRONMENT**

DEEP/ SHALLOW/ ARCTIC
BOTTOM TYPE
SALINITY
BIOLOGICS
SHIPPING
SOUND VELOCITY PROFILE

TORPEDO INITIALIZATION DATA

FIRING SOLUTION

LAUNCH

PLATFORM COMBAT SYSTEM

EXTERNAL QUEING

PLATFORM SONAR

WARHEAD EFFECTIVENESS SIMULATION (LFT&E)

# Requirements Letter

A TYPICAL REQUIREMENTS LETTER FROM COMOPTEVFOR CONTAINS THE FOLLOWING:

- SYSTEM DESCRIPTION - MODEL WILL REPRESENT THE SYSTEM

- INTENDED USES - PRE-TEST PLANNING, PREDICTION, POST-TEST ANAL., "REST OF THE ENVELOPE"

- PROGRAMMATIC ISSUES AND RECOMMENDATIONS FROM PAST LESSONS LEARNED

- GENERAL REQUIREMENTS

- VV&A DOCUMENTATION REQUIREMENTS

# Requirements Letter Continued

- STATEMENT OF NEED FOR INFORMATION ASSURANCE
- SUPPORT REQUIREMENTS - FACILITIES, TIME, MANPOWER
- LIST OF COIs, MOEs, THAT CAN BE SUPPORTED BY M&S, REQUIREMENTS SUPPORTING EACH, AND PROPOSED MODEL
- LIST OF DRAFT TEST SCENARIOS
- LIST OF SIMULATION RUNS TO SUPPORT DRAFT TEST SCENARIOS

# Requirements Letter Continued

THIS LETTER, GENERATED BEFORE MILESTONE B, IS CRITICAL IN DEFINING THE SCOPE OF WORK REQUIRED TO SUPPORT RESOLUTION OF COIS BUT ALSO HELPS PROGRAM MANAGERS TO BUDGET AND PLAN FOR M&S.

IT SHOULD BE REALIZED THAT THIS LETTER IS INPUT TO THE PROGRAM MANAGERS ACCREDITATION PLAN AND DOES NOT CONTAIN DETAILED TECHNICAL PERFORMANCE REQUIREMENTS THAT THE PM MAY WANT TO SUPPORT TRADE STUDIES AND EVALUATE PRELIMINARY DESIGN PERFORMANCE.

REQUIREMENTS FROM THIS LETTER + PMs TECHNICAL REQUIREMENTS = BASELINE REQUIREMENTS FOR THE ACCREDITATION PLAN.

# Designating Simulations

- PM Designates
  - Based on DT and OT Requirements
  - (Vice Selecting Before Establishing Requirements)
- COMOPTEVFOR Does Not Designate
  - Is a Programmatic Decision
- PM Designated Simulations Entered Into Part III (DT) and Part IV (OT)

# Acceptability Criteria

- COMOPTEVFOR as AA is Responsible
- Developers are Most Knowledgeable
- Must be a Team Effort
- Early Working Relationship is Instrumental
- Must Agree on Metrics
  - abs value, %, expected response, engineering judgement
- Review as a Team
- Incorporate Criteria into V&V & A Plans

# Other Issues

– Accrediting Targets, External Entities
  - Drones
  - Digital Representations of Targets
  - Representation of Enemy Units

– Accrediting Community Used Simulations
  - Endgame Simulations
  - Environment Representation

– Accrediting Legacy Simulations
  - Case by case basis

# Model Management Plan

- Required by COMOPTEVFORINST 5000.1

- Purpose
  - Apply Project Management Disciplines
  - Identify Organizational Roles
  - Identify Resources Required

# Notional VV&A Project Schedule

| ID | Task Name | Duration | 0 Q3 | Q4 | 2001 Q1 | Q2 | Q3 | Q4 | 2002 Q1 | Q2 | Q3 | Q4 | 2003 Q1 | Q2 | Q3 | Q4 | 2004 Q1 | Q2 | Q3 | Q4 |
|----|-----------|----------|------|----|---------|----|----|----|---------|----|----|----|---------|----|----|----|---------|----|----|----|
| 2 | **DT Start** | **1 day** | | | | | | | | | | | ■ | | | | | | | |
| 4 | **OA** | **1 day** | | | | | | | | | | | | | | ■ | | | | |
| 6 | **OPEVAL** | **1 day** | | | | | | | | | | | | | | | | ■ | | |
| 8 | **M&S Designation Phase** | **180 days** | ▬ | ▬ | ▬ | | | | | | | | | | | | | | | |
| 9 | Develop M&S Requirements | 90 days | | ▭ | | | | | | | | | | | | | | | | |
| 10 | Designate Simulations | 30 days | | | ▭ | | | | | | | | | | | | | | | |
| 11 | Develop Acceptability Criteria | 90 days | | | ▭ | | | | | | | | | | | | | | | |
| 12 | **VV&A Planning Phase** | **90 days** | | | | ▬ | | | | | | | | | | | | | | |
| 13 | Develop Accreditation Plan | 90 days | | | | ▭ | | | | | | | | | | | | | | |
| 14 | Establish Boards | 30 days | | | | ▭ | | | | | | | | | | | | | | |
| 15 | **V&V Execution Phase** | **240 days** | | | | | ▬ | ▬ | ▬ | | | | | | | | | | | |
| 16 | Develop V&V Plan | 90 days | | | | | ▭ | | | | | | | | | | | | | |
| 17 | Execute V&V Plan | 180 days | | | | | ▭ | ▭ | | | | | | | | | | | | |
| 18 | Develop V&V Report | 30 days | | | | | | | ▭ | | | | | | | | | | | |
| 19 | Develop V&V Assessment Report | 30 days | | | | | | | ▭ | | | | | | | | | | | |
| 20 | **Accreditation Phase** | **90 days** | | | | | | | ▬ | | | | | | | | | | | |
| 21 | Review V&V Assessment Report | 30 days | | | | | | | ▭ | | | | | | | | | | | |
| 22 | Prepare Accreditation Package | 30 days | | | | | | | ▭ | | | | | | | | | | | |
| 23 | AA Accreditation Decision | 30 days | | | | | | | ▭ | | | | | | | | | | | |

# VV&A 'Spiral Development' Schedule

| ID | Task Name | Duration | 2000 | | | 2001 | | | | 2002 | | | | 2003 | | | | 2004 | | | | |
|----|-----------|----------|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 |
| 1 | **Program Key Events** | **371 days** | | | | | | | | | | | | | | | | | | | | |
| 2 | **DT Start** | **1 day** | | | | | | | | | | | | | | | | | | | | |
| 4 | **OA** | **1 day** | | | | | | | | | | | | | | | | | | | | |
| 6 | **OPEVAL** | **1 day** | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | |
| 9 | **DT M&S Designation Phase** | **180 days** | | | | | | | | | | | | | | | | | | | | |
| 13 | **DT VV&A Planning Phase** | **90 days** | | | | | | | | | | | | | | | | | | | | |
| 16 | **DT V&V Execution Phase** | **240 days** | | | | | | | | | | | | | | | | | | | | |
| 21 | **DT Accreditation Phase** | **90 days** | | | | | | | | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | | | | | |
| 26 | **OA/OT M&S Designation Phase** | **120 days** | | | | | | | | | | | | | | | | | | | | |
| 28 | **OA VV&A Planning Phase** | **30 days** | | | | | | | | | | | | | | | | | | | | |
| 30 | **OA V&V Execution Phase** | **120 days** | | | | | | | | | | | | | | | | | | | | |
| 32 | **OA Accreditation Phase** | **90 days** | | | | | | | | | | | | | | | | | | | | |
| 34 | | | | | | | | | | | | | | | | | | | | | | |
| 35 | **OT VV&A Planning Phase** | **30 days** | | | | | | | | | | | | | | | | | | | | |
| 37 | **OT V&V Execution Phase** | **120 days** | | | | | | | | | | | | | | | | | | | | |
| 39 | **OT Accreditation Phase** | **90 days** | | | | | | | | | | | | | | | | | | | | |

# TEMP Part V

| TYPES OF RESOURCES | OT-IIA | OT-IIB PHASE I | OT-IIB PHASE II |
|---|---|---|---|
| TEST ARTICLES | | | |
| TEST SITES AND INTRUMENTATION | | | |
| TEST SUPPORT EQUIPMENT | | | |
| TEST TARGETS/ EXPENDABLES | | | |
| FLEET TEST SUPPORT | | | |
| OPERATIONAL FORCE TEST SUPPORT | | | |
| **SIMULATIONS AND MODELS** **WAF** | AS REQU'D | AS REQU'D | AS REQU'D |
| SPECIAL REQUIREMENTS | | | |
| MANPOWER AND TRAINING | | | |
| COMPUTER SUPPORT | | | |
| POST OT-IIIA DATA HANDLING | | | |

# V&V Report/ Accreditation Report

- Proponent Responsible for V&V Report
  - Review at Technical and Managerial Boards ending up with V&V Assessment Report
- COMOPTEVFOR Responsible for Accreditation Report for OT (PM for DT)
  - Incorporates V&V Report Data
  - PM sends as a package with certification letter to COMOPTEVFOR
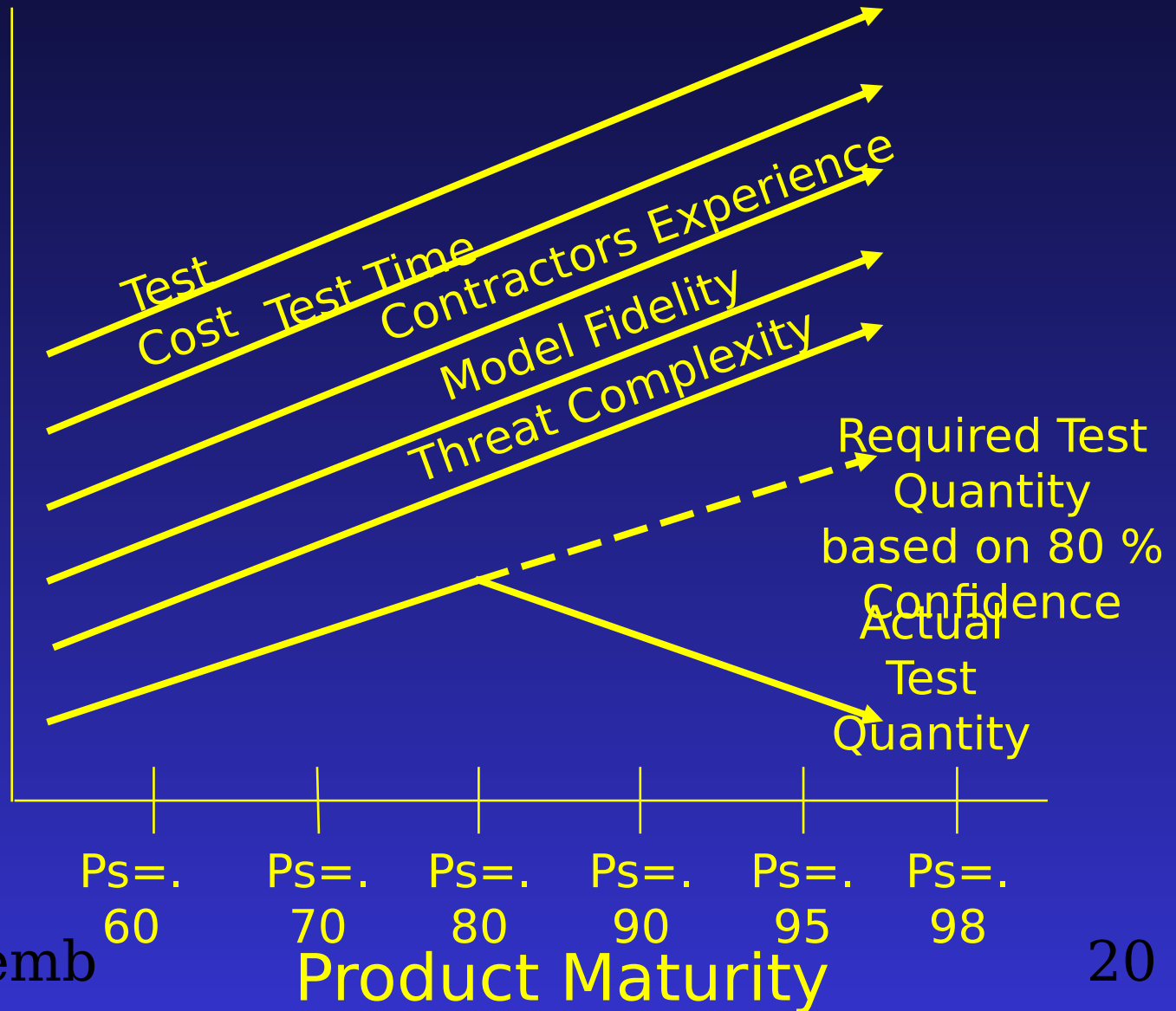
# Why Simulate?

Critical

Factors

Test

Cost  Test Time

Contractors Experience

Model Fidelity

Threat Complexity

Required Test Quantity based on 80 % Confidence

Actual Test Quantity

Ps=. 60      Ps=. 70      Ps=. 80      Ps=. 90      Ps=. 95      Ps=. 98

Product Maturity

# PROCESS per SECNAV 5200.40

| Accreditation Authority For OT | Accreditation Authority For DT | Accreditation Review Panel | Simulation Control Panel | Models and Simulations Proponent |
|---|---|---|---|---|

**(E) Provide input to Main P.O. who will give to ARP for inclusion into the Accreditation Plan**

**(D) Designate for M&S Accreditation**

**M&S VV&A Designation Letter**

**(D) Establish ARP** — *ARP Charter*

**(D) Develop Model Mgmt. Plan & Accreditation Plan (Including POA&M) with PMs, Developers, & COTF**

**M&S Accreditation Plan (AA Approval)**

**(E) Develop CM Plan**

**(D) Establish SCP** — *SCP Charter*

**V&V Plan Guidelines**

**(E) Develop V&V Plan** — *V&V Plan (SCP Approval)*

**(A) Review data package (V&V report) and make accreditation Decision for Operational Test**

**(A) Review/Approve M&S Accred. Recommendation letter & package for OT & send to AA for OT (COMOPTEVFOR)**

**M&S Accreditation Recommendation Letter for OT**

**(A) Prepare M&S Accred. Rec. letter for OT with data package.**

**(E) Execute V&V Plan**

**V&V Report Guidelines**

**(E) Develop V&V Reports for DT and OT Tests** — *V&V Report (SCP Approval)*

**(E) Develop V&V Assessment Report for DT and OT**

**(A) Decision for M&S Accreditation for DT**

**M&S Accreditation Recommendation Letter for DT**

**(A) Prepare M&S Accreditation Recommendation Letter for DT**

**V&V Assessment Report (ARP Approval)**

*CM Plan*

**(A) Send an M&S Accreditation Notification letter with report to Main Program Office (AA for DT) & copy to CNO (N091)**

**(A) Issue M&S Accreditation Notification Letter**

**M&S Accreditation Decision Letter**

**(A) Update M&S Catalog Entry**

**(A) Update M&S Catalog Entry** — *M&S Catalog Entry*

**CNO (N091)**

**(D) = Designation Phase**   **(E) = Execution Phase**   **(A) = Accreditation Phase**

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# When?

| TASK \ PHASE | PHASE A CONCEPT | PHASE B SYSTEM DEV. AND DEMO | PHASE C PRODUCTION & DEPLOYMENT | FRPD- FULL RATE PROD. DEPLOYMENT |
|---|---|---|---|---|
| PLANNING ORGANIZING | | Mgmt. / Process, Model Description, OT Req. Input, VV/A, Config. Mgt., All Plans in place by start of Phase B | | |
| BOARD & TECH MTGS. | | | Periodicity Monthly? Quarterly? | |
| Verification & Validation TASKS | Validate Concept, verify functional models and system models, validate results, Software Design Doc., User's guide, Programmers' manual, CM Plan, Data documents, Progress reported at critical Program reviews - IPR, PDR, CDR, SSR, etc. | | | |
| Simulation Runs | Test Planning, Pre-Test Prediction and Analysis, Assess and evaluate performance not proven by test, Post-Test Analysis | | | |
| DT / IOT&E | | DT    IOT&E | | |
| AA for DT Accreditation letter & proof to COTF | | | AA for DT Accred. Letter & Letter to COTF w/VV&A Pkg. | |
| COTF (AA for OT) letter of accreditation & Report | | | COTF (AA for OT) letter(s) of accreditation & Reports | |
| LRIP DECISION | | | | |
| TECH / OP. EVAL | | | TECH    OPEVAL | |
| AA for DT Accreditation letter & proof of VV&A | | | | AA for DT Accred. Letter & Letter to COTF w/VV&A Pkg. |
| COTF (AA for OT) letter of accreditation & Report | | | | AA for OT letter(s) accred. & Reports |
| Full Rate Prod. | | | | FOT&E |

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# What "accredited" Means in Operational Test

- Accredit for a Specific Use
- Accredit for a Particular Phase or Test Event
- Accredit for a Specific M&S Version
- High Confidence in Output Results of M&S
- Supplement OT&E Only (Does Not Replace)
- M&S Must be Re-Accredited for Follow-on Tests, Newer Versions of M&S, or Major Upgrades to Weapons System
- A model is - Digital, HIL, Land Based Test Systems, Targets (threat rep. Or surrogate), Target sims./stims. Or any combination

# Cost Savings?

- No direct cost savings for new M&S
- No direct cost savings for new M&S
- No direct cost savings for new M&S

# How Much does it cost?

- Scientists and Programmers' Cost - ?? As high as X% of total program cost?

- Verification, Validation, and Accreditation and the paper documentation required by Department of Defense require a significant % of total program cost.

- Each program is unique - Do detailed cost estimate.  Place in TEMP Part V as resource requirement.

# Benefits of M&S?

- Cost Avoidance - designers and testers catch problems early "before" going to test. Allows a problem solution early. Costs $1 to solve early, costs $10 or more to solve late.

- Possible Future Savings - Legacy M&S may cost less to modify for a new revision of an existing design.

- Practical Necessity - As Cost/Time/complexity constraints dictate less testing, M&S is the only alternative to boost confidence.
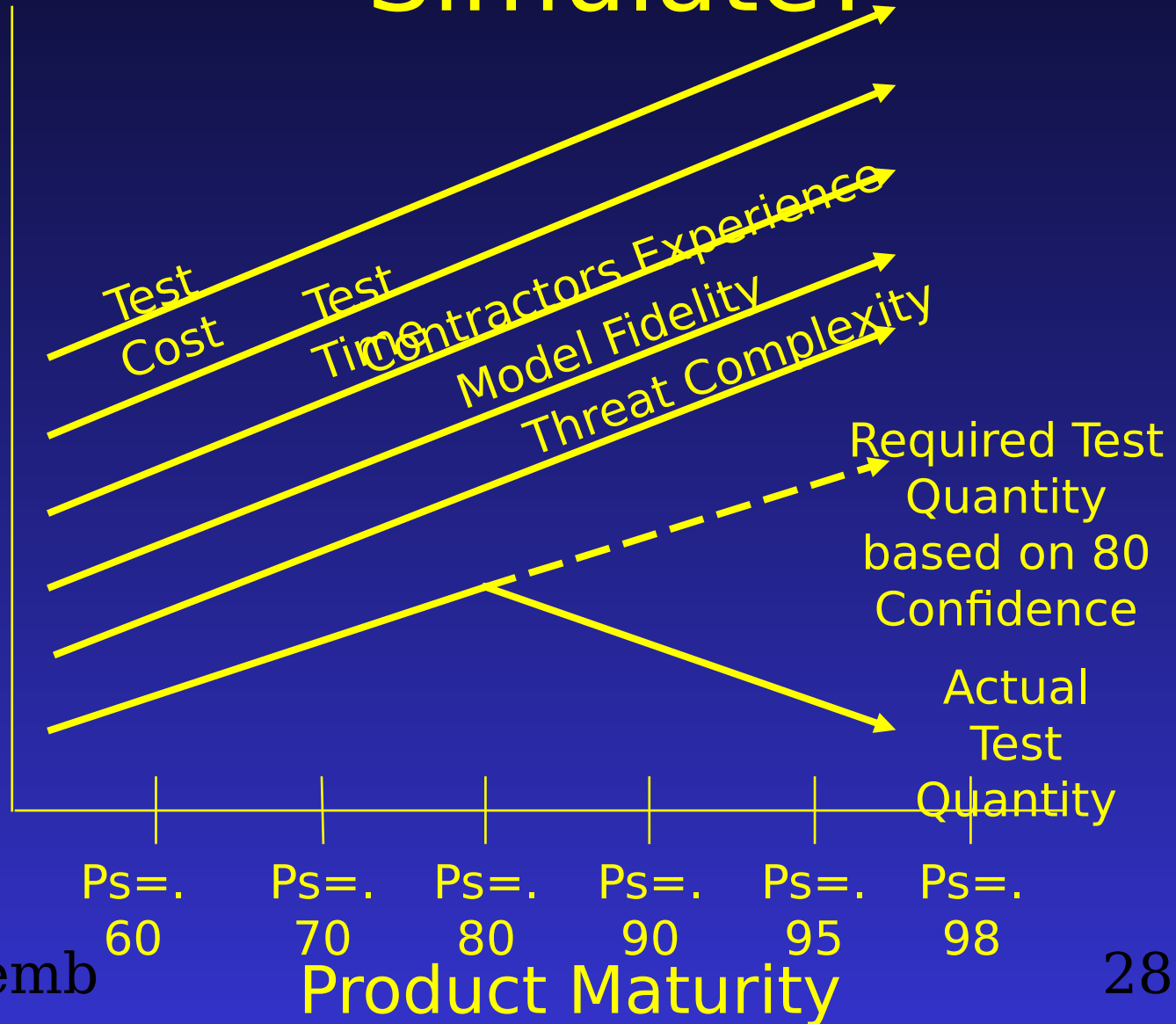
# V&V AGENTS

- Joint Accreditation Support Activity, (JASA)
- Center for Naval Analysis (CNA)
- John Hopkins University (JHU/APL)
- Old Dominion University Research Foundation
- Threat Systems Office (TSO) China Lake, CA (Steve Wireman)
- Naval Surface Warfare Center Dahlgren Div.
- Naval Research Laboratory (NRL)
- Others

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Product Maturity

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|---|---|---|---|---|

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# Surface Warfare Programs

- Tomahawk
- Navy Area and Theater Wide
- CEC
- RAM
- Pra (Both Navy wide & LPD-17)
- LAM/LAM FCS (ALAM)

- ESSM
- ERGM
- TAKE
- AEGIS
- DD-21 Related
- Various Radar (SPQ-9B & others)
- CIWS